REMARKS

This application contains claims 1-65. Claims 12 and 14-18 have been canceled without prejudice. Claims 1, 13, 19, and 24 are hereby amended. No new matter has been introduced. Reconsideration is respectfully requested.

Claims 8 and 9 were objected to for covering the same subject matter, on the grounds that the "union of interim domains" recited in claim 8 is similar to the "set of relations" recited in claim 9. Without relating to whether "domains" and "relations" can really be equated in this manner, Applicant respectfully points out that claim 8 recites the added limitation that "building the network of the hyper-arcs comprises representing the set of relations as a disjunction of multiple relations..." There is no suggestion in claim 9 of this sort of limitation. Therefore, Applicant believes that claims 8 and 9 are patentably distinct, and this objection should be withdrawn.

Claims 1-31 were rejected under 35 U.S.C. 101 for being directed to non-statutory subject matter. Applicant has amended independent claims 1, 19 and 24 in order to overcome this rejection, by incorporating limitations previously stated in claim 12 (now canceled). The amended claims recite a method for testing a system, based on building a network of hyper-arcs representing relations among variables that are characteristic of inputs to the system under test. Values of the inputs to be made to the system are found by determining respective output domains of the variables. Claim 13 has been amended to depend from claim 1, while claims 14-18 have been canceled. Thus, claims 1, 19 and 24 are now believed to meet the requirements of 35 U.S.C. 101, as are claims 2-11, 13, 20-23 and 25-31, which depend from these independent claims.

Claims 1-65 were rejected under 35 U.S.C. 102(b) over Mackworth ("Consistency in Networks of Relations"). Applicant respectfully traverses this rejection.

Mackworth describes algorithms for solving a constraint satisfaction problem (CSP) based on maintaining arc consistency. These algorithms include the Boolean procedure "REVISE," listed by Mackworth on page 104, lines 8-18 (cited on page 3, lines 21-31, in the present patent application). As noted in the present patent application (page 5, lines 14-18), Mackworth's method requires that constraints be given as a logical relation, represented as an explicit set of valid combinations of

variable values, or revealed through a predicate. This requirement is exemplified by Mackworth's expression of a prototypical CSP on page 100, lines 4-5, and his exclusive use of the Boolean predicates $P_j(y)$ and $P_{ij}(x,y)$ in representing the arcs of his CSP.

Claim 1, as amended, recites a method for testing a system based on building a network of hyper-arcs representing a set of relations among variables that are characteristic of inputs to the system. Each hyper-arc corresponds to one of the relations and links nodes in the network corresponding to the variables that are subject to the relation. The variables linked by each of the hyper-arcs are <u>assembled in a hierarchy based on the relation corresponding to the hyper-arc</u>. The input domains of the variables in the hierarchy are reduced in order to determine output domains consistent with the relations. The output domains determine the values of the inputs to be made to the system under test.

In rejecting this claim, the Examiner made reference to the above-mentioned "REVISE" procedure in Mackworth and indicated that this procedure includes the steps of assembling the variables in a hierarchy and reducing the input domains of the variables in the hierarchy, as recited in claim 1. Mackworth does not use the term "hierarchy," however, and the Examiner did not point out any term or data structure in Mackworth that might be considered equivalent to a hierarchy. The only guidance given by the Examiner in this regard was to note that Mackworth refers to systems of three variables (top of page 4 in the Official Action).

The existence of multiple variables, however, does not prove or even suggest that the variables are somehow arranged in a hierarchy, let alone the specific hierarchy recited in claim 1. As noted in MPEP 2111.01:

> Ordinary, simple English words whose meaning is clear and unquestionable, absent any indication that their use in a particular context changes their meaning, are construed to mean exactly what they say.

The word "hierarchy" is defined in *Webster's Third New International Dictionary* as "the arrangement of objects, elements, or values in a graduated series" or "a series of objects, elements or values so arranged." Hierarchies of this sort are shown in Figs. 3 and 6 of the present patent application, for example. Mackworth's variables, on the other hand, simply have arbitrary subscripts (*i, j, k*), which have nothing to do with any sort of <u>hierarchical</u> ordering.

MPEP 2131 goes on to state:

TO ANTICIPATE A CLAIM, THE REFERENCE MUST TEACH EVERY ELEMENT OF THE CLAIM... "The identical invention must be shown in as complete detail as is contained in the... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Since Mackworth neither teaches nor suggests the use of hierarchies recited in claim 1, Applicant respectfully submits that this claim is patentable over Mackworth. In view of the patentability of claim 1, claims 2-11 and 13, which depend from claim 1, are also believed to be patentable.

Claim 19, as amended, recites a method for testing a system based on building a network of hyper-arcs representing a set of constraints among variables that are characteristic of inputs to the system. The constraints include <u>a relation among at least three of the variables</u>. The input domains of the variables in the network of hyper-arcs are reduced in order to determine output domains consistent with the constraints. The output domains determine the values of the inputs to be made to the system under test.

Claim 19 was rejected on the same grounds as claim 1. In support of this contention, the Examiner pointed out that Mackworth refers to systems of three variables (top of page 4 in the Official Action). With respect to relations among the variables, however, Mackworth discloses only unary predicates ($P_j(y)$) and binary predicates ($P_{ij}(x,y)$). Mackworth neither teaches nor suggests the use of relations involving at least three variables, such as $P_{ijk}(x,y,z)$. The methods that Mackworth describes for achieving arc consistency are, by themselves, simply inapplicable to relations involving three or more variables. The present invention provides a solution to this shortcoming. Therefore, claim 19 is believed to be patentable over Mackworth, as are claims 20-23, which depend from claim 19.

Claim 24, as amended, recites a method for testing a system based on building a network of hyper-arcs representing a set of constraints among variables that are characteristic of inputs to the system. The constraints include one or more relations defined as <u>a combination of operators</u>, selected from a group of arithmetic, bitwise and logical operators, which are applied to the variables. The input domains of the variables in the network of hyper-arcs are reduced in order to determine output

domains consistent with the constraints. The output domains determine the values of the inputs to be made to the system under test.

In rejecting claim 24, the Examiner asserted that the use of constraints comprising one or more relations defined as a combination of operators is described by Mackworth on page 104, lines 2-8. The cited passage describes domains D_i and D_j for two variables v_i and v_j, with respective values x and y and a predicate $P_{ij}(x,y)$, which are used in the arc consistency algorithm described subsequently. The passage makes no mention or suggestion of a relation between variables defined as a combination of operators, as required by claim 24, nor is there any such suggestion elsewhere in Mackworth. (Section 7.2, on page 108 of Mackworth deals with "operations on relations," which is a different and separate notion from defining relations as a combination of operators applied to variables, as taught by the present invention.) Therefore, claim 24 is believed to be patentable over Mackworth, as are claims 25-31, which depend from claim 24.

Claims 32, 50 and 55 are independent apparatus claims, which recite apparatus for solving a constraint satisfaction problem based on principles similar to the methods of claims 1, 19 and 24, respectively. These claims were rejected with reference to the passages in Mackworth cited above, as well as other passages relating to path consistency (pages 107-109). Therefore, for the reasons explained above with reference to claims 1, 19 and 24, independent claims 32, 50 and 55 are believed to be patentable over the cited art, as are dependent claims 33-49, 51-54 and 56-62.

Claims 63-65 are independent product claims, which recite computer software for solving a constraint satisfaction problem. These claims are likewise based on principles similar to the methods of claims 1, 19 and 24, respectively, and were rejected on similar grounds to the apparatus claims. Thus, for the reasons explained above, claims 63–65 are believed to be patentable over the cited art.
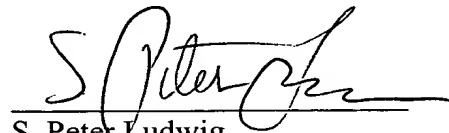
Although Applicant has not specifically argued the patentability of the dependent claims, these dependent claims are believed to recite independently-patentable subject matter, notwithstanding the patentability of the independent claims. Arguments with respect to the dependent claims have been omitted in the interest of brevity.

Applicant has studied the additional references made of record by the Examiner, and believes that all the claims in the present patent application are

patentable over these references, whether the references are taken individually or in any combination.

Applicant believes the amendments and remarks presented hereinabove to be fully responsive to all of the objections and grounds of rejection raised by the Examiner. In view of these amendments and remarks, Applicant respectfully submits that all of the claims in the present application are in order for allowance. Notice to this effect is hereby requested.

Respectfully submitted,

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